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COMMONWEALTH OF PENNSYLVANIA
BOARD OF FISH COMMISSIONERS

FISH PONDS FOR THE LAND OWNERS

By
C. R. BULLER
Deputy Commissioner of Fisheries

Harrisburg, Pennsylvania
1926

FISH POND FOR THE LAND OWNERS.

By C. R. Buller, *Deputy Commissioner of Fisheries.*

Many inquiries are received at the office of the Board of Fish Commissioners from parties seeking information on the construction and maintenance of private fish ponds. It is the policy of the Board to lend every assistance possible towards this work. Upon request engineers are sent to make suggestions and give advice in reference to the construction. Fish cultural advice is given with reference to the stocking and maintenance of the pond. In addition to this, upon written request to the Harrisburg Office, pond owners are furnished with a fish cultural application which, when properly filled out and returned, will secure for a start in the new pond those species of fish which cannot conveniently be purchased from commercial hatcheries, and which are usually best suited for the pond owners.

Privately owned ponds can be made not only a source of food supply for the family use, but in many instances where time and study is given the venture, a supply of fish will be available for market purposes. If due care is given to the planting of the pond with aquatic vegetation and beautifying the surrounding landscapes, it may be made a place of rest and comfort for the grownups as well as a place of recreation for the little folks and in many instances may provide a handy place for securing the winter crop of ice.

As no two ponds or pond sites are identical, no fixed set of rules can be laid down for their construction and maintenance. The following paragraphs simply relate some of the requirements necessary for their success:

Pond Construction: Before starting to build, the proposed site should be gone over carefully, positive assurance should be made of an adequate supply of water for all times; grades and levels taken; all natural advantages utilized; dangers from floods taken into consideration, and a thought as to the species of fish intended to be reared. It is also well to bear in mind at this time that perhaps in the future as success is attained the number of ponds will be increased. Unless time and study is given this work, the results are usually disappointing. The time that the average farmer or land owner can devote to his fish pond is limited. And again most pond sites are best adapted for the warm water species of fish. By the term warm water fish is meant the fish found in our lakes, ponds. and large streams. With these thoughts in mind, the Board usually

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recommends the stocking of the pond with fish that will propagate naturally and can be fed on artificial food. Hence, the information contained herein relative to construction and maintenance is for ponds intended for warm water fishes.

Source of Water Supply: Springs are usually the best sources of water supply when they are known to be thoroughly dependable at all times and of sufficient flow to prevent stagnation; however, in maintaining ponds with warm water fish, the summer temperature must not be too low. If the quantity of spring water entering the pond is of large enough volume to lower the temperature below sixty-five degrees fahrenheit during the summer months, the water not required to keep up the pond levels and to prevent stagnation should not be permitted to flow through the ponds. In ponds fed from springs the danger of undesirable species of fish entering the pond is eliminated. This is not the case when the water supply is taken from nearby streams, lakes or ponds.

Size of Pond: In rearing warm water fishes, the larger the body of water the better the chance of success. Disappointment usually results from ponds less than an acre in area. The larger the ponds the better the conditions can be made for natural reproduction, for the maintenance of a natural food supply, and growth of aquatic plant life. Different ranges in depth can be had which will provide shallow feeding grounds, and also deeper portions for protection during the winter months or extremely hot weather. The temperature is also more evenly maintained and this has a direct bearing on the well being of the microscopic food supply of the baby fish.

Locating the Pond. In locating the pond sites, all natural advantages should be utilized. Many times the contour of the land is such that hillsides form one of the embankments. Natural depressions can be used to advantage, and, where drainage permits, swamps and low wet lands can be excavated at little expense. Owing to the difficulty of controlling floods, the danger of undersirable species of fish entering the pond, and the difficulty of properly screening the overflow, main streams should never be dammed for the purpose of a privately owned fish pond.

Building the Pond: Ponds are usually constructed of earth or concrete embankments, or a combination of the two. However, earth embankments are best adapted to warm water fishes and should be used whenever possible. The success of the venture will depend a great deal upon the proper construction of the pond, especially the embankment, for upon it the existence of the water supply in the pond will depend. It is well, where possible, to obtain the assistance of an engineer to properly lay out the sites, giving grades,

levels, etc. In the construction of earth embankments, the first step is to properly prepare the foundation or place upon which the embankment is to rest. Most surface soil, although apparently solid, is full of holes made by small animals and insects, and is more or less porous due to the roots of plants, brush, trees, etc. If the embankment is constructed on a foundation of soil of this type, leaks will usually occur; hence, where the embankments are to be constructed, all sods, brush, trees, etc., should be removed. The remaining soil should be well plowed and harrowed and the furrows thrown from the center of the foundation towards the outside edges. This operation should be continued until a well formed ditch is made sloping from the inside towards the center. The size and depth of the ditch will depend upon the condition of the soil and the size of the embankment. Where pockets of gravel, sand, or soil of a porous nature are encountered, they should be removed and the excavations filled with well rammed clay or hardpan. If the foundation soil is of clay or hardpan nature, little danger will be encountered from leaks between the foundation and the embankment. Where a stone foundation is encountered, it is a difficult matter to build an earth embankment upon it without seepage. The best course to pursue is to dig a trench through the stone removing all loose particles and portions showing open seams and cracks. This trench should then be filled with concrete so that the concrete wall extends several feet above the foundation acting as a core wall in the embankment.

Earth Embankment: Usually sufficient soil can be taken to good advantage from the pond bottom for the erection of the embankment. However, no sods, logs, large stones, or soil of a gravelly or porous nature should be used. Hardpan and clay soils make the most water-tight jobs. The width of the embankment will depend upon the size and depth of the pond; however, in most cases the work is done with the teams and scoops. This being the case, the embankments should be built wide enough for the operation of the team; the soil should be placed on the bank in uniform layers, not to exceed eight inches and should be well compacted either by hauling of the material or by other methods. When the embankment is constructed in uniform layers, it will settle more evenly making it more water-tight, and the finished work will be free from unsightly depressions.

Concrete Embankments: When concrete embankments are used, expert advice should be obtained with reference to the thickness of the wall, baffle, etc. Under seepage will occur unless the foundations are dug deeply enough to encounter a clay or hardpan soil. Concrete ponds are not ideal for warm water fish. When the embankments are of concrete, it is recommended that earth be thrown against the

inside of the pond wall in such a manner that a well-sloping shore line will be established.

Intake: Properly constructed intakes are necessary to regulate the water supply and prevent fish from entering or leaving the pond. The water can be conducted to the pond through open ditches, wooden or iron pipes. The pipes are more satisfactory; as they eliminate the dangers encountered from floods or leaks caused by burrowing animals, and valves can be attached which enable the flow to be easily regulated. Intakes should be screened to prevent them from clogging, as well as to retain the fish. A convenient way to do this is to construct a concrete box at the source of water supply, having the top and the end facing the water supply open. In the end facing the supply where screens can be inserted grooves are placed. The pipe is conducted from the inside of the box to the pond. The top of the box is left open to enable the operator to clean the screens and regulate the valves. It is well to have the top of the box extend well above the flood levels. If this is not practical, a covering of planks which will be a protection during flood periods should be bolted over the top.

Spillways and Overflows: At no time should water be permitted to flow over the embankment, but spillways should be provided for this purpose. They should be constructed in such a manner that they can be properly screened to prevent the fish from leaving the pond, and that stop planks can be used to maintain the proper water level and lower the ponds. They should also be constructed so that the ponds can be drained with a catchbasin on the outside of the spillway to retain or hold the fish as the water is being lowered. The spillways in the warm water fish ponds at Pennsylvania's hatcheries are constructed so that when the fish are removed the water is gradually lowered and the fish collect in the spillway; this eliminates the use of drag seines which usually results in the rolling of the fish in the mud, algae, etc., and in the loosening and tearing up of the aquatic vegetation. Upon request, complete drawings of the type of bulkheads used will be furnished the pond owners. They consist of two parallel concrete walls extending through the earth embankment on the lower side or outward portion of the embankment. They extend a distance of approximately eight feet. The distance between the two walls is determined by the amount of water to be carried off. Opposite one another on the portions of the walls extending into the pond are inserted two grooves three inches deep and three inches wide for the insertion of screens and stop plank. On the portions of the wall extending through the outward side of the embankment is placed another set of grooves where screens and stop planks can be inserted when

drawing off the pond. The bottom of the spillway is made of con crete. The first or inside section extending about halfway through the embankment is several inches lower than the pond bottom; for the purpose of insuring drainage. Below this is a drop of about twelve inches. When drawing down the ponds and removing the fish, screens and stop planks are placed in the outward grooves. The stop planks raise the water high enough to make approximately eight inches of water in the lower sections of the spillway. In this pocket, the fish collect as they leave the ponds and can be removed without injury to them, or to the pond bottom.

Pond Bottom: The dirt from the pond bottom for the erection of the embankment should be removed in such a manner that it will slope from all points towards the spillway. All holes or depressions should be so filled that when the pond is empty no pools of water where the fish can hide remain. Along one or more shore lines, shallow shelves where the water ranges in depths from six to eighteen inches, should be permitted to remain. These shelves make ideal spawning beds as well as a place for protection and forage ground for the baby fish. Through the lower half of the pond the depth should be sufficient to eliminate the danger of freezing solid during the winter months

Number of Ponds: Where space is available and the land owner wishes to go into the venture on a larger scale, it is suggested that a series of ponds be constructed, where the fish can be sorted and separated according to their size. The poultryman would not think of brooding baby chicks with grown hens nor is it a good economy for the fish grower to brood his baby fish with the mature stock. While some species of fish are more cannibalistic than others, it is a known fact that most fish will destroy their own young—goldfish not excepted. By having a series of at least three ponds with the properly constructed spillways, such as described above, it is a simple matter to drain the ponds and sort the fish. In addition to this, a record can be taken during the transfers of the number of fish on hand, and any undesirable specie that might have entered the pond can be disposed of.

Floods: Time and money should not be considered in protecting the ponds from floods. Due to the cutting of the timber, the runoff during the rain storms and the melting of snow have increased the danger of floods ten fold in the last few years. What could be more discouraging than the loss of the fish crop and the destruction of the pond caused by a few hours of rain fall? Where ponds are constructed with the creek bordering on one side of the embankment, it is advisable to riprap the bank with stones, or better yet to con-

struct a concrete retaining wall of sufficient height to eliminate any danger of the rapid current undermining the embankment during floods. Where ponds are constructed against hillsides, often times the flow of surface water entering the pond during storms is sufficient to cause damage. This condition can be overcome by carrying the surface water around the ponds in trenches.

Brook and Brown Trout: In the foregoing chapters, neither the brook or brown trout have been considered. To successfully rear trout requires an adequate supply of spring water at all times, special equipment for caring for the eggs and baby fish, series of ponds where fish can be sorted for sizes, and men trained in the handling and feeding of the fish. On the average country estate, the requirements of a trout hatchery are not available, and the time that the owner can devote to his fish ponds is usually limited. However, when the cost of keeping the pond stocked is not considered and where sufficient spring water is available to prevent the water from exceeding sixty-five degrees fahrenheit during the summer months, a trout pond can be established. Brook trout will not reproduce naturally in artificial ponds. They are also very cannibalistic. Because of this, in order to maintain a supply of fish, it is necessary to restock the water frequently with fish of approximately the same size as those already in the pond. These fish would have to be purchased from a commercial trout hatchery at a considerable expense to the owner. In Pennsylvania, at the present time, there are a number of commercial trout hatcheries operating on a paying basis. These plants are under the supervision of trained men; the water supply and location are ideal for the rearing of trout; and markets have been established for their output. The Board of Fish Commissioners suggests that parties wishing to enter into the propagation of trout have the proposed site looked over by men trained along this line of work.

Bass: By many sportsmen the bass are looked upon as the gamest of all Pennsylvania's fish. What could be finer than a privately owned bass pond where these game fighters could be retained in large enough numbers to provide real sport for the angler? But unfortunately the bass are one of the most difficult of Pennsylvania's fish to grow to maturity in small bodies of water, one reason for this being their peculiar feeding habits. As yet, the fish culturists have been unable to produce an artificial food upon which the bass will feed and thrive. This being the case, they must be fed upon their natural food from the time the baby bass leave their nests until they are caught by the fishermen as mature fish. In the bass ponds conditions must be made natural for the growth and reproduction of minute organisms which provide food for the baby fish for the

first few weeks of their existence. After leaving these feeding stages, their chief food throughout life is other fish, brother and sister of the same school will readily devour each other, and the parent fish will feed upon their own offspring, as well as all other species.

To provide fish as food for a pond of healthy vigorous bass is no small task, as it requires a number of forage ponds and a knowledge of how to propagate the minnow or forage fish.

From investigations made on many of the small lakes of Pennsylvania having a water area of from thirty to one hundred acres, it has been found in every instance where bass have been introduced, sacrifice of the other fish has resulted. In other words, the fish of the masses, such as the catfish, the yellow perch, and the sunfish have been destroyed to afford the bass fisherman a few days of sport each season.

Where bass are introduced into a body of water inhabited by other fish, they will thrive and reproduce very rapidly for the first few years. As they gradually destroy the old inhabitants of the pond, they will start feeding upon one another. In a few years, only sufficient bass are left in the ponds to keep down the growth of other fish to such an extent that it affords poor fishing for other fishermen as well as the bass fishermen. At one of Pennsylvania's state hatcheries, approximately one hundred and fifty acres of water are devoted to the propagation of bass. In order to feed each year's crop, until they are of the proper size for releasing in the public waters, it requires ninety-eight additional acres for the rearing of forage fish.

Yellow Perch: Where yellow perch are introduced into a pond of one acre or more, there will probably be good results; since they are very prolific, reproduce naturally, can be induced to feed upon artificial food, are caught on hook and line, and have fine table qualities.

Breeding Habits: In Pennsylvania, the yellow perch spawn in April or May. The eggs come forth in a long accordion plaited veil like ribbon and are entwined among the brush, old logs, or aquatic plant life in such a manner that they do not settle to the bottom. By being thus suspended, they receive a slight circulation of water around them, caused by the wave action and are prevented from being smothered by sediment. As spawning time approaches, it is well to place brush along the shore line submerged to a depth of from eighteen to twenty-four inches. This will afford a spawning place for the fish. As a rule, at this season of the year, the aquatic plant life has not advanced sufficiently to support the eggs. If the baby fish are to be reared in the pond with the parent fish, it is suggested that the perch eggs not be molested, but care should be taken to maintain the proper water levels in the pond preventing

the eggs deposited in the shallow water from being left on dry ground. At the approach of spawning season, where nursery ponds are used, they should be rid of all other fish life, brush should be placed around the shore line, and the eggs transferred from the brood ponds to the brush in the nursery ponds. In removing the eggs, the mass can be transferred from the brush with the hands and gently floated in to pails of water. They can then be carefully entwined about the brush in the nursery ponds and not disturbed until they hatch.

Feeding the Yellow Perch: In order to feed fish artificially, it requires considerable time and expense. Fish should be fed regularly each day, and only such an amount as they will consume. Waste food lying on the bottom will contaminate the water. Where the land owner cannot devote his time to this work, it is suggested that the brood pond be well stocked with forage fish. The Board of Fish Commissioners have found the golden shiner well adapted for this purpose, as it reproduces at the proper time of the year for its offspring to furnish food for the baby fish during the summer months.

In the artificial feeding of yellow perch, they can be induced to feed upon clabbered cow's milk and finely chopped liver and heart of the sheep or beef. In feeding the larger fish, several convenient places along the pond bank should be chosen to feed them. The fish will soon learn to seek these places at the proper time.

When the yellow perch first hatch they are very tiny and with the unaided eye are difficult to see in the ponds. When they break from the shell of the egg, they have attached to the lower portion of their bodies yolk bags or food sacs. The contents of these sacs furnish them with nourishment for their first five to seven days. After the absorption of the food sacs, they begin taking food through their mouths. It is a difficult matter to furnish these tiny creatures with artificial food. If the pond bottoms are in proper condition; that is, having a healthy growth of plant life, an abundance of submerged logs, old brush, etc., nature will provide food for the babies in the form of minute aquatic organisms until they have reached a length of about one-half inch. Then they can be induced to take clabbered cow's milk. This milk is introduced along the shore lines by shaking it through a small hand net made of fine bobbinet. This process breaks it up into very fine particles. After the fish reach a length of one and one-half to two inches, finely chopped hearts and livers from the beef and sheep can be substituted for the milk.

Sunfish (Blue Gill): In Pennsylvania, are found a number of different species of sunfish, one or more kinds inhabiting most of the lakes and ponds throughout the State, the common sunfish, or pumpkin-seed being the most abundant. He is a game little fish

ard has good pan qualities, but does not grow large enough to make him a worth while fish for pond culture. For this reason, the Pennsylvania Board of Fish Commissioners rear the blue gill sunfish for stocking purposes.

The blue gill sunfish is the largest and most sought after of the sunfish family. It grows to a length of from eight to twelve inches, has excellent pan qualities, is very gamey, reproduces naturally, thrives in almost any body of water not having too low a summer temperature, and feeds readily on artificial food.

Breeding Habits: In Pennsylvania, the spawning period of the blue gill sunfish is an extended one. Usually a pond of blue gills will start nesting in May and continue until August. Their breeding habits resemble very much those of the black bass. A saucer shaped depression eighteen to twenty-four inches in diameter, is excavated on the gravel banks by the fin action of the fish until the nest is free from sediment and only the clean gravel remains. The eggs are extruded upon these gravel beds. They are of a sticky nature, adhering to the cleanly washed gravel. The parent fish hovers in and about the nest all during the period of incubation, and by the fin action sediment is kept from the eggs, and all intruders are driven away. The parental protection is kept up until the eggs hatch and the baby fish are large enough to leave the nests. When the baby fish hatch, they are almost microscopic in size, and unless the nests are examined carefully, they are very difficult to see. They stay over and about the nest until the yolk bag or food sac is absorbed, and then each individual goes its way.

Owing to the long drawn out spawning period and to the small size of the fish when first hatched, it is very difficult to remove them from the brood ponds until September or October. Even at this time of the year, baby sunfish of many different sizes will be found in the pond. Where the pond owner wishes to rear the baby fish in separate ponds, it is suggested that the sorting take place in the fall of the year. Although sunfish, to a certain extent, will feed upon their own offspring, they are not as cannibalistic as many other kinds of fish and wonderful success has been obtained by rearing all sizes in the same pond, if the pond bottoms are in a proper condition to insure a good supply of natural food for fish of all sizes, and of aquatic plants dense enough to afford a place of protection for the young.

Feeding Sunfish: The feeding of the sunfish is a simple matter; they feed upon a variety of foods belonging to both the animal and vegetable kingdom. For this reason, where the ponds are not over crowded and conditions are favorable for the growth of a natural food supply, artificial feeding will not be required. If the fish are confined in large numbers, artificial feeding will be necessary. At

Pennsylvania's hacheries, the sunfish are fed clabbered cow's milk, whole wheat bread, wheat middlings, and finely chopped beef hearts and livers. The clabbered cow's milk is introduced into the ponds by the same method which is used in feeeding the yellow perch.

Where sunfish are the only inhabitants of the pond, it is not recommended that forage fish be introduced. Part of the adult sunfishes diet consists of fish life; and it will feed upon its own offspring, but not sufficiently to do any serious damage to the young. The average forage fish will consume more baby sunfish than will the adult sunfish itself. Again, it is a difficult matter to find a forage fish that spawn late enough in the year to furnish food for the sunfishes tiny offspring. The average baby minnow will be feeding upon the baby sunfish before Fall.

Catfish: Throughout the United States are found many different species of catfish. Of all these, the catfish best adapted for pond culture in Pennsylvania is the common bullhead. Under favorable conditions, the common bullhead grows to a length of from twelve to fifteen inches. He is found in almost every body of still water and is readily taken by the hook and line.

Breeding Habits: The bullhead will reproduce naturally. Spawning takes place in Pennsylvania usually during the month of June. At the approach of this season, the bullheads roam in pairs along the shore lines seeking a suitable place for the nest building. When the site is located, a hole is dug in the bank by the use of the sharp spines on the fins, and the loosened particles of earth are removed either by the mouth or violent fin action. The holes are from six to eight inches in diameter and from six to eighteen inches deep.

A female catfish will deposit from three hundred to three thousand eggs depending upon her age and size. The eggs come forth in a round gelatinous mass. The parent catfish remain in and about the hole constantly on guard during the entire period of incubation. Provided with the sharp spines on their dorsal and pectoral fins, they are well equipped to protect the home from all enemies. A free circulation of water is kept moving over the eggs by the fin action, and if the eggs settle in the soft mud, they are lifted and their position changed by the parent catfish sucking the ball in her mouth and blowing it out again.

Under certain conditions at the state hatcheries the catfish eggs are hatched artificially on a hatching battery; but, as yet, the fish culturist have not been able to improve on the parent bullheads' mode of caring for the eggs and very young fish. For this reason, where possible, at the state hatchery, the parent fish are permitted to deposit their eggs and care for their babies until they leave the nest. When the catfish first hatch, they are a delicate pink color. As the

yolk bag is gradually absorbed, they become darker, resembling the color of the mature catfish. After the absorption of the yolk bag and at the time the baby fish begin to take on a darker color, the parents bring them in great schools from the nests in search of food. For ten to twenty days, they are brooded along the shoreline by the parent fish, much as an old hen hovers about her flock of chickens. After a time, the parent fish desert the offspring and the schools break up. Just before the School breaks up at the state hatcheries, the baby catfish are transferred to nursery ponds where they can have the attention of the trained fish culturist. However, success can be attained by permitting them to remain in the same pond as the parents.

Feeding Catfish: Where the bullhead pond has a soft mucky bottom, has a healthy growth of plant life, and is not overstocked, bullheads will require no artificial food. Where it is necessary to resort to artificial feeding, the fish of all sizes can be fed on clabbered cows milk or finely crushed beef or sheep plucks. They can also be induced to feed upon whole wheat bread, wheat middlings, etc. Although bullheads will feed upon other fish, they are considered bottom feeders and take most of their nourishment from the insect life inhabiting the pond bottom. They are competitors for the same food as that consumed by the forage fish. For this reason, it is not suggested that forage fish be introduced into the bullhead pond.

A Combination of Fish for the Pond: Many pond owners are desirous of stocking their pond or ponds with several species of fish. In order to do this successfully, fish should be chosen that are not competitors for the same kind of food. A good combination is the blue gill sunfish and the catfish. Again, in the larger bodies of water, say from three to ten acres in area, the yellow perch, blue gill sunfish, and catfish can be introduced, using the golden shiner as a forage fish for the yellow perch.

Pond Bottoms: The success of rearing warm water fish depends a great deal upon the aquatic plant life in the ponds. Some of the benefits derived from the plant life are as follows:

Fish life is dependent upon vegetable life for its food supply. Although a few fish feed directly upon vegetable matter, the aquatic plant life serves chiefly as an organizer of more desirable fish food. Animals cannot organize inorganic matter, but as food matter that is already organized such as animal subjects. Plants do organize inorganic matter into food, using mineral salts that occur in the water and soil and using gasses that are found in the air and in the water.

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